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Nishioka

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(54) **SLIDE RAIL AND IMAGE FORMING APPARATUS**

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F16C 29/00 (2006.01)
G03G 21/16 (2006.01)
A47B 88/16 (2006.01)

(52) **U.S. Cl.**
CPC ***F16C 29/005*** (2013.01); ***A47B 88/16*** (2013.01); ***G03G 21/1623*** (2013.01); *G03G 2221/1684* (2013.01)

(58) **Field of Classification Search**
USPC 312/333, 334.1, 334.7–334.8, 334.11, 312/334.17, 334.44–334.46; 384/18, 21; 399/393
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,577,821 A * 11/1996 Chu 312/334.11
5,722,750 A * 3/1998 Chu 312/334.11
6,220,683 B1 * 4/2001 Chu 312/334.44
6,238,031 B1 * 5/2001 Weng 312/333
6,257,683 B1 * 7/2001 Yang 312/333
6,386,660 B1 * 5/2002 Yang 312/334.46
6,402,275 B1 * 6/2002 Yang 312/334.46
6,715,851 B1 * 4/2004 Yang 312/334.46
8,528,999 B2 * 9/2013 Chen et al. 312/334.45
2002/0043915 A1 * 4/2002 Chan 312/334.46
2002/0175605 A1 * 11/2002 Chen et al. 312/333

FOREIGN PATENT DOCUMENTS

JP S53-137921 U 10/1978
JP 2001-304255 A 10/2001
JP 2005-173522 A 6/2005
JP 2007-000253 A 1/2007
JP 2011-107575 A 6/2011
JP 2011-159716 A 8/2011
JP 2011-172830 A 9/2011

OTHER PUBLICATIONS

An Office Action; "Notice of Reasons for Rejection," issued by the Japanese Patent Office on Oct. 7, 2014, which corresponds to Japanese Patent Application No. 2012-192592 and is related to U.S. Appl. No. 14/015,789.

* cited by examiner

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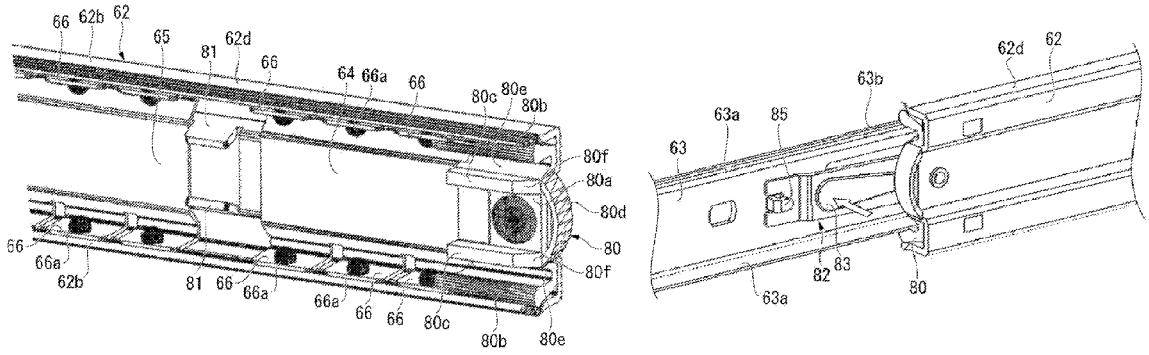
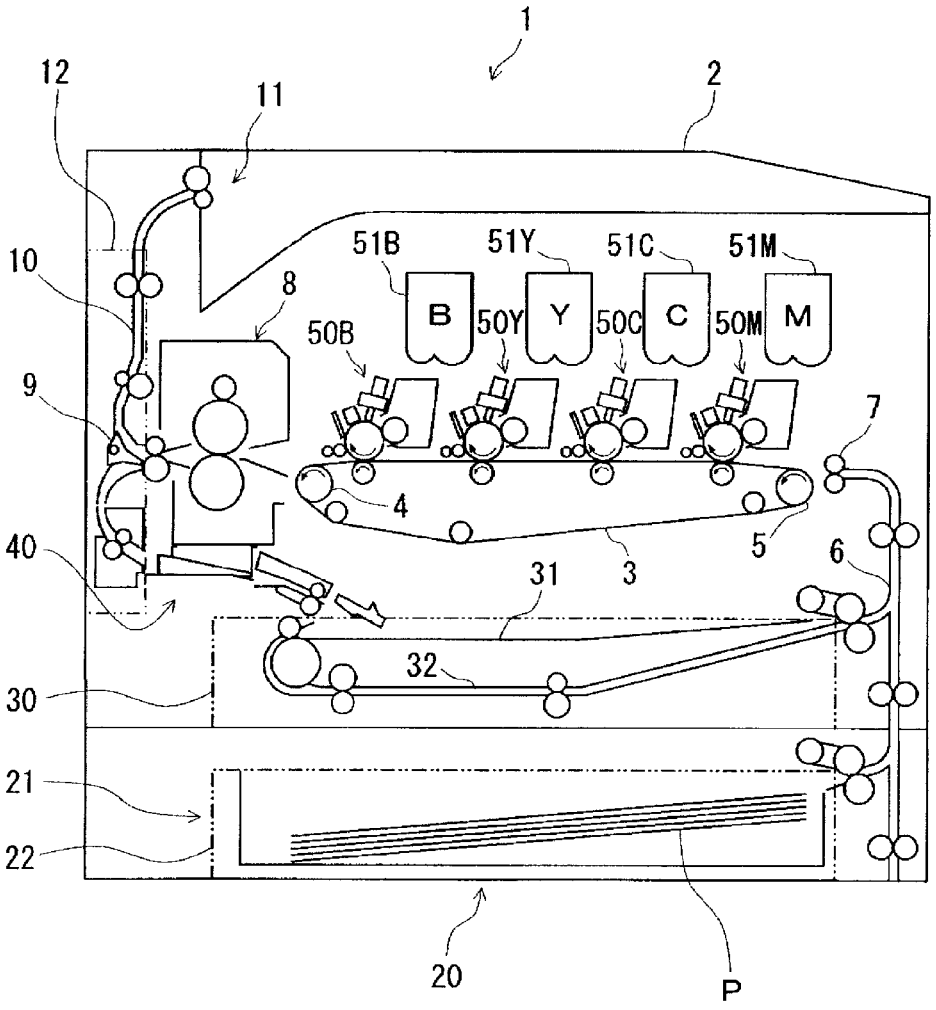
(57) **ABSTRACT**

A slide rail includes a plurality of ball retainers, a fixed rail, and a moving rail. The moving rail is capable of being inserted into and drawn out from the fixed rail by being pulled frontward of the fixed rail to be taken out from the plurality of ball retainers or by being inserted into the plurality of ball retainers from front. The plurality of ball retainers are arranged in the sliding direction along the fixed rail. The plurality of ball retainers include a guide retainer arranged on a front end part of the fixed rail. The fixed rail includes a restriction member configured to restrict sliding of the guide retainer rearward of the fixed rail.

10 Claims, 6 Drawing Sheets

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11
2
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51B
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51M
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50Y
Y
50C
C
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7
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31
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21
22
20
P

FIG. 1

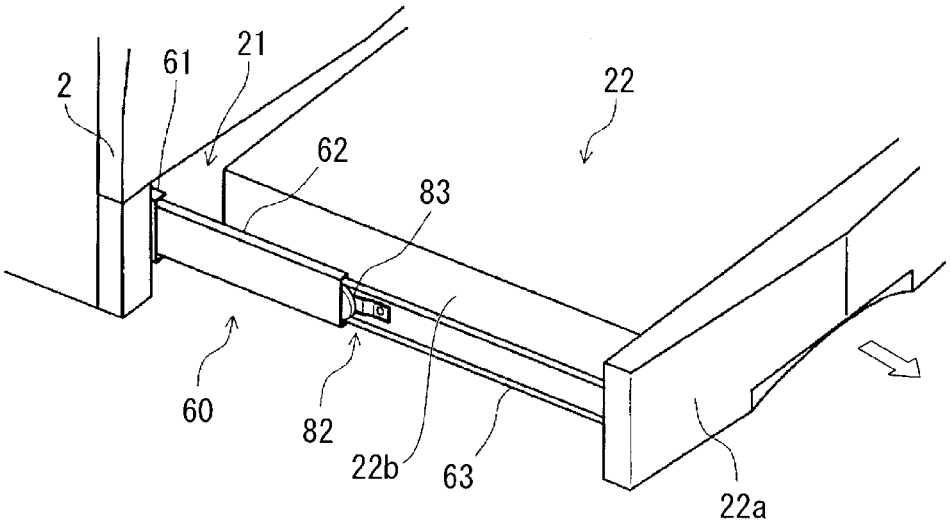


FIG. 2

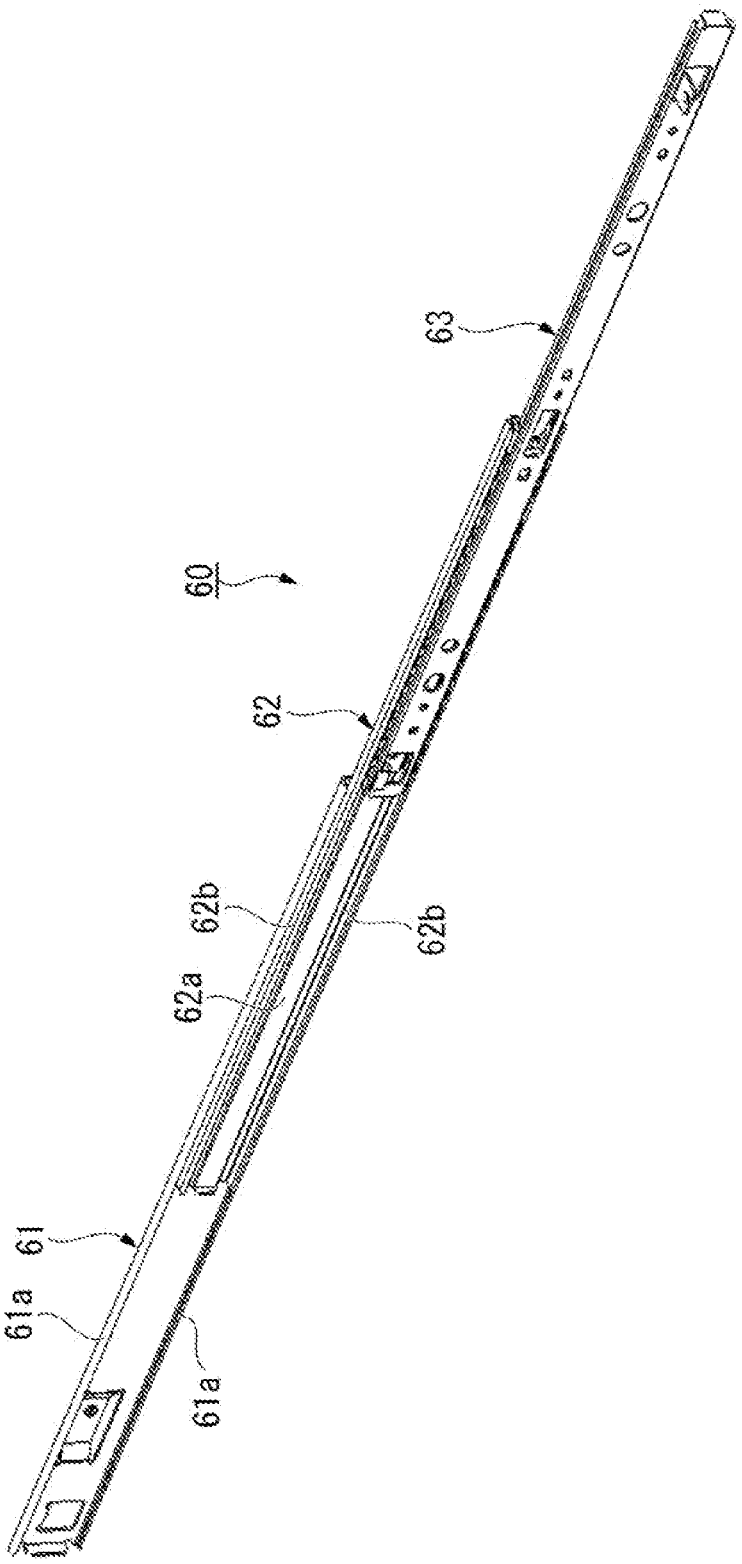
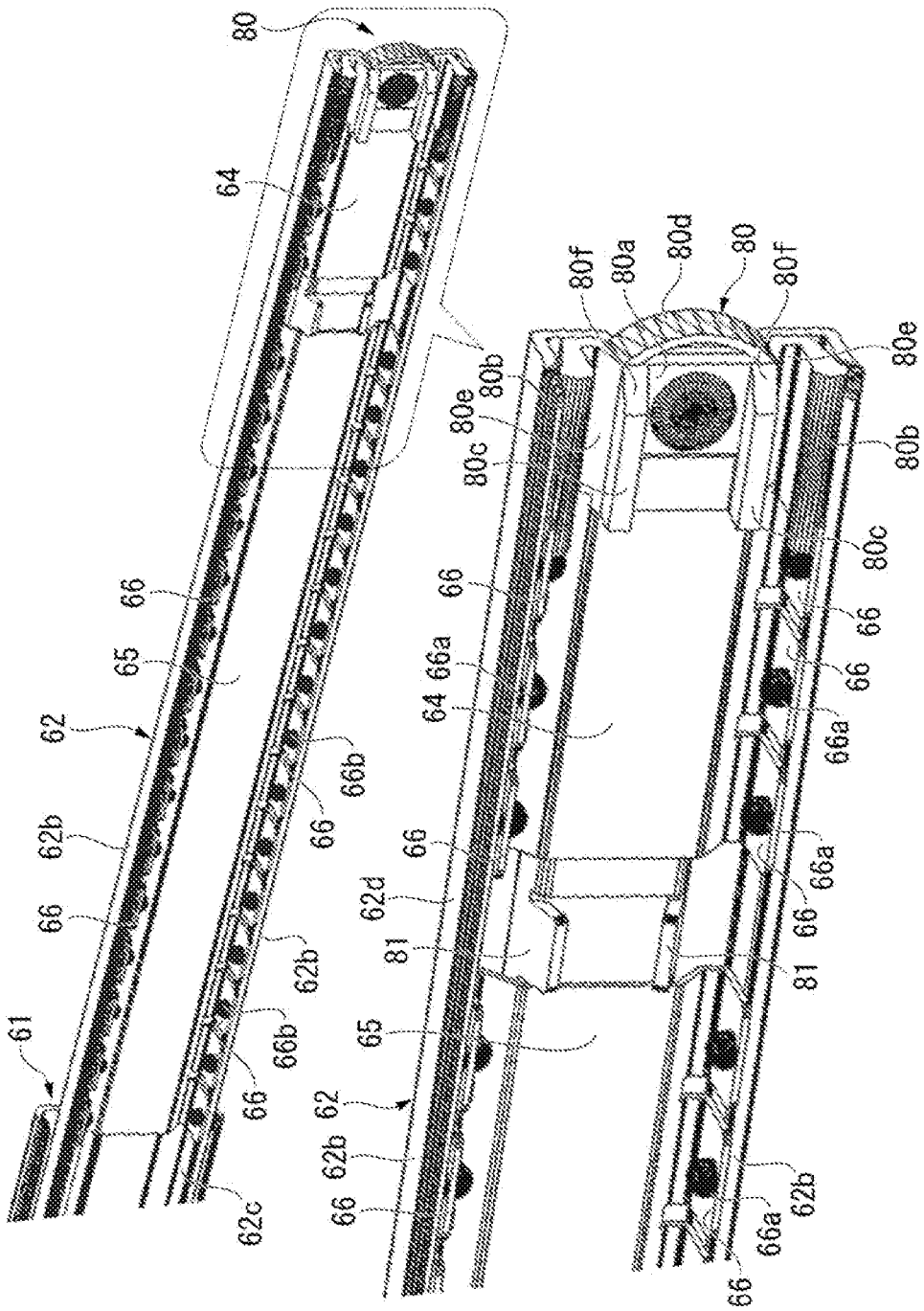


FIG. 3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80c
80b
80c
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66a
66

FIG. 4A

FIG. 4B

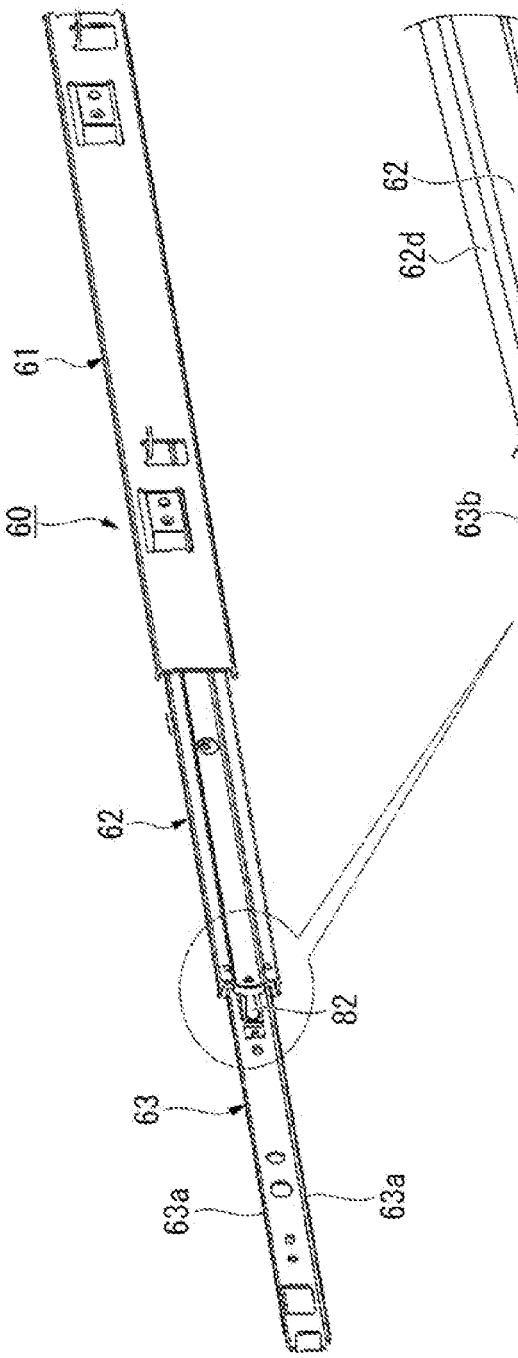

FIG. 5A

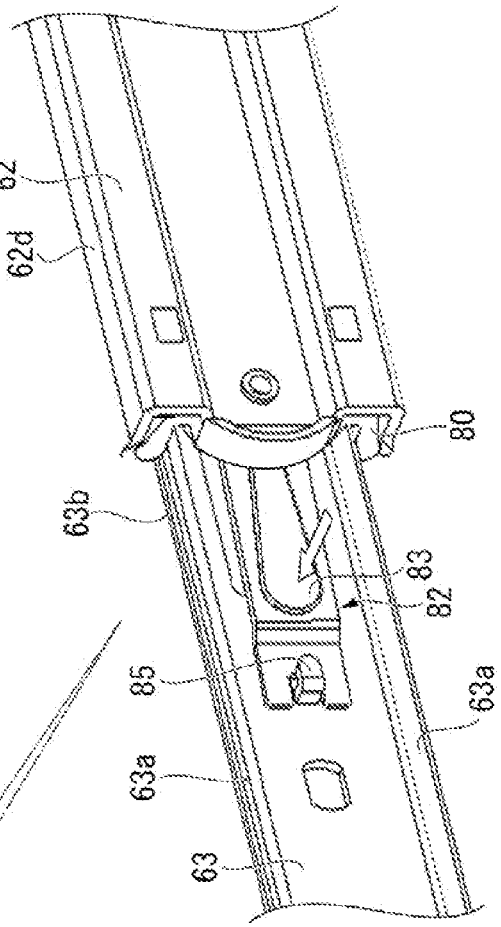

FIG. 5B

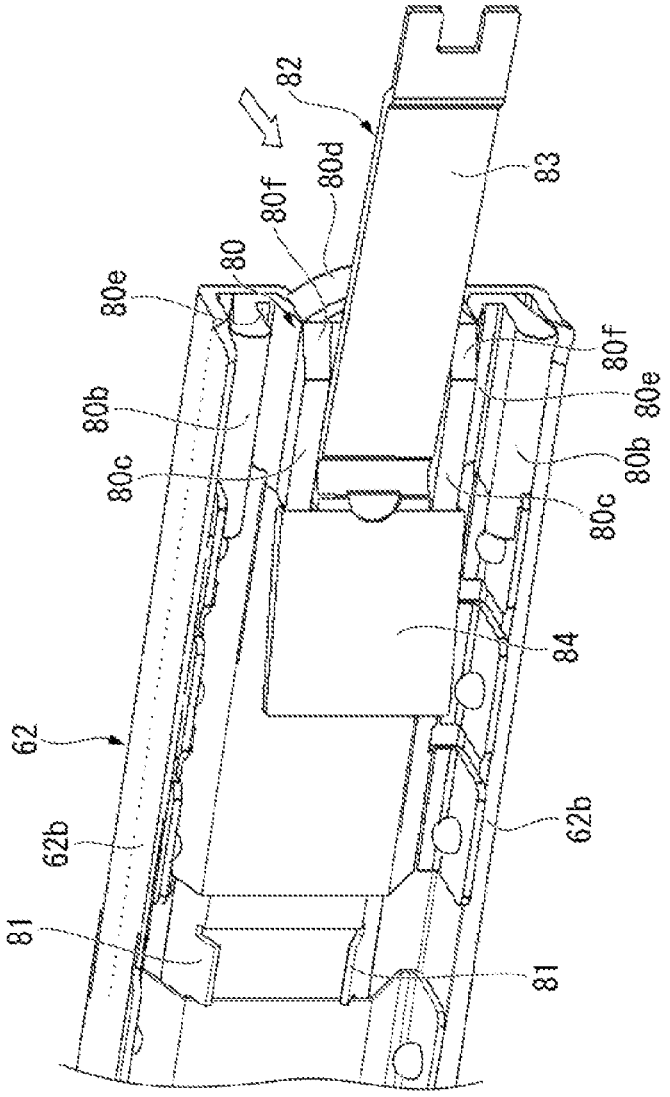

FIG. 6

SLIDE RAIL AND IMAGE FORMING APPARATUS

INCORPORATION BY REFERENCE

The present application claims priority under 35 U.S.C. §119 to Japanese Patent Application No. 2012-192592, filed Aug. 31, 2012. The contents of this application are incorporated herein by reference in their entirety.

BACKGROUND

The present disclosure relates to slide rails and image forming apparatuses.

For sheet feed cassettes in image forming apparatuses, such as copiers, etc., slide rails are provided to facilitate putting in/taking out, that is, insertion/drawing of the sheet feed cassettes relative to the main bodies of the image forming apparatuses. Besides this, in drawers for furniture and kitchens, slide rails are also provided to facilitate putting in/taking out, that is, insertion/drawing of the drawers from their corresponding main bodies. As such a slide rail, for example, a structure has been known which is provided with a fixed rail having a substantially C-shaped cross section fixed at an equipment main body of an image forming apparatus and a moving rail having a substantially C-shaped cross section slidably held by the fixed rail through a ball retainer that includes ball bearings.

A recent demand is that sheet feed cassettes, drawers, and the like are detachable from their corresponding main bodies in an operation, such as maintenance. In order to be detachable, some type of slide rail includes a support member on the inner surface of the front end part of the fixed rail to support the front end part of the moving rail. In the support member, a support protrusion is formed which protrudes toward the moving rail and being in contact with a bent edge of the moving rail.

SUMMARY

A slide rail according to the present disclosure includes a plurality of ball retainers, a fixed rail, and a moving rail. The plurality of ball retainers include ball bearings. The fixed rail is provided so that the plurality of ball retainers slide in a sliding direction. The moving rail is arranged in the fixed rail and is configured to engage with the ball bearings to be slidable relative to the plurality of ball retainers. The moving rail is capable of being inserted into and drawn out from the fixed rail by being pulled frontward of the fixed rail to be taken out from the plurality of ball retainers or by being inserted into the plurality of ball retainers from front.

The plurality of ball retainers are arranged in the sliding direction along the fixed rail. The plurality of ball retainers include a guide retainer arranged on a front end part of the fixed rail. The fixed rail includes a restriction member configured to restrict sliding of the guide retainer rearward of the fixed rail.

An image forming apparatus according to the present invention includes a main body, an image forming section, a fixing section, and a drawer member. The image forming section and the fixing section are provided in an interior of the main body. The drawer member is capable of being drawn from the main body. The drawer member is accommodated so as to be capable of being inserted in and drawn from the main body through the aforementioned slide rail.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a configuration diagram schematically showing a printer according to one embodiment of the present disclosure.

FIG. **2** is a perspective view showing the main part and the vicinity of a part where a slide rail is mounted.

FIG. **3** is a perspective view showing a schematic configuration of the slide rail.

FIG. **4**A is an illustration showing the inner side of a middle rail, and FIG. **4**B is an enlarged view of the main part of FIG. **4**A.

FIG. **5**A is a perspective view of the slide rail as viewed from its obverse side, and FIG. **5**B is an enlarged view of the main part of FIG. **5**A.

FIG. **6** is an illustration showing the inner side of the middle rail.

DETAILED DESCRIPTION

Embodiments of the present disclosure will be described below with reference to the accompanying drawings. It is noted that each members are appropriately changed in scale in the below-mentioned drawings so as to be recognizable.

First of all, an image forming apparatus according to one embodiment of the present disclosure will be described roughly with reference to FIG. **1**. FIG. **1** is a vertical front cross sectional view schematically showing a configuration of a tandem type color printer as one example of the image forming apparatus.

In a printer **1** in FIG. **1**, either full color image output or monochrome image output is selected according to color information of original document image data from an external computer.

A transfer/conveyance belt **3** is disposed in the interior of a main body **2** of the printer **1**. The transfer/conveyance belt **3** is wound between and supported by a drive roller **4** and a driven roller **5**. The transfer/conveyance belt **3** conveys a sheet P horizontally from right to left in FIG. **1**. The transfer/conveyance belt **3** is used for transferring a toner image to the sheet P. A sheet feeder **20**, a sheet conveyance path **6**, and a registration roller **7** are arranged on the upstream side in a sheet conveyance direction of the transfer/conveyance belt **3**. A fixing section **8**, a branch section **9**, a sheet conveyance path **10**, and an ejection section **11** are disposed on the downstream side of the transfer/conveyance belt **3**. The ejection section **11** is arranged on the top surface of the main body **2**.

A duplex printing unit **30** is disposed below the transfer/conveyance belt **3** between the transfer/conveyance belt **3** and the sheet feeder **20**. The duplex printing unit **30** includes an intermediate tray **31** and a sheet conveyance path **32**. The intermediate tray **31** switches the conveyance direction for the sheet P. In the present embodiment, the duplex printing unit **30** and the sheet feed cassette **22** in the sheet feeder **20** serve as drawer members capable of being pulled out from the main body **2**.

Four image forming sections are arranged above the transfer/conveyance belt **3** in series from the upstream side to the downstream side in the sheet conveyance direction. The four image forming sections are a magenta image forming section **50**M, a cyan image forming section **50**C, a yellow image forming section **50**Y, and a black image forming section **50**B in the order from the upstream side. In order to replenish the image forming sections with toner, toner supply containers **51**M, **51**C, **51**Y, **51**B are provided for the image forming

sections **50**M, **50**C, **50**Y, **50**B, respectively, so that each image forming section is replenished with toner by a conveyance means (not shown).

On the left side of the main body **2**, a side cover **12** is provided which is capable of exposing the fixing section **8**, the branch section **9**, and the sheet conveyance path **10**. The side cover **12** is turnable about its lower end as a rotation axis with its upper end serving as a free end.

The printer **1** configured as above performs an image output operation as follows.

The sheet P, which is sent from the sheet feeder **20** through the sheet conveyance path **6**, reaches the registration roller **7**. The registration roller **7** sends the sheet P onto the transfer/conveyance belt **3** in synchronization with each image forming section. The image forming sections **50**M, **50**C, **50**Y, **50**B transfer magenta, cyan, yellow, and black toner images, respectively, to the sheet P sequentially, thereby forming a color image on the sheet P.

Then, the sheet P carrying the non-fixed color toner image is sent to the fixing section **8**. Thereafter, the toner is heated and melted by a heating roller in the interior of the fixing section **8** to be fixed to the sheet P. The sheet P ejected from the fixing section **8** passes through the branch section **9** and the sheet conveyance path **10** and is then ejected onto the ejection section **11** provided on the upper surface of the main body **2**.

For duplex printing, the conveyance direction for the sheet P is changed downward in the branch section **9**. The sheet P sent downward from the branch section **9** passes through the conveyance unit **40** and goes from left to right in FIG. **1** onto the intermediate tray **31** provided in the duplex printing unit **30** to be stored thereon temporarily. Next, the conveyance direction for the sheet P is switched to left. Then, the sheet P is sent again to the registration roller **7** through the sheet conveyance path **32**.

A slide rail according to one embodiment of the present disclosure will be described next.

As described above, in the present embodiment, the sheet feed cassette **22** of the sheet feeder **20** and the duplex printing unit **30** are the drawer members capable of being drawn out from the main body **2**. Slide rails are mounted between the sheet feed cassette **22** and the main body **2** and between the duplex printing unit **30** and the main body **2**. That is, the sheet feed cassette **22** and the duplex printing unit **30** are accommodated in the main body **2** so as to be capable of being inserted into and drawn out from the main body **2** through the slide rails.

FIG. **2** is an illustration for explaining the state in which the sheet feed cassette **22** is pulled out from the main body **2**. FIG. **2** is a perspective view showing the main part and the vicinity of a part where a slide rail **60** is mounted. As shown in FIG. **2**, a sheet feed cassette accommodating section **21** is formed in the lower part of the main body **2** of the printer **1**. The sheet feed cassette **22** is provided in the interior of the sheet feed cassette accommodating section **21**. The sheet feed cassette **22** is connected to and supported by the sheet feed cassette accommodating section **21** in the main body **2** and is accommodated in the interior of the sheet feed cassette accommodating section **21** so as to be capable of being inserted and drawn through the slide rail **60**. The slide rail **60** is arranged and mounted on a side surface a cassette main body **22***b*. The sheet feed cassette **22** is capable of being drawn out in a manner that the front part of the sheet feed cassette **22**, that is, a front panel **22***a* mounted on the front surface of the cassette main body **22***b* is pulled horizontally frontward, as indicated by the arrow in FIG. **2**.

The slide rail **60** is mounted on a side surface of the sheet feed cassette **22** between the sheet feed cassette **22** and the sheet feed cassette accommodating section **21** in the lower part of the main body **2**. It is noted that the slide rail **60** is arranged so that the obverse side and the reverse side of the slide rail **60** face outward and inward, respectively. Accordingly, the obverse side is shown in FIG. **2**.

FIG. **3** is an illustration showing a schematic configuration of the slide rail **60**. FIG. **3** is a perspective view of the slide rail **60** as viewed from another side. The slide rail **60** in the present embodiment includes an outer rail **61**, a middle rail **62**, and an inner rail **63**. The outer rail **61** and the middle rail **62** form a fixed rail according to the present disclosure. The inner rail **63** forms a moving rail according to the present disclosure. As shown in FIG. **2**, the outer rail **61** is mounted on the main body **2** in the interior of the sheet feed cassette accommodating section **21**. By contrast, the inner rail **63** is mounted on the side surface of the sheet feed cassette **22** (on the side surface of the cassette main body **22***b* in the example shown in FIG. **2**).

As shown in FIG. **3**, the outer rail **61** is a slender metal plate-like rail having a substantially C-shaped transverse cross section. The middle rail **62** is slidably held in the interior of the outer rail **61**, that is, between a bent edge **61***a* and a bent edge **61***a*, which are formed on the opposite side parts of the outer rail **61**. The middle rail **62** is a metal rail having a substantially C-shaped transverse cross section that is slightly smaller than that of the outer rail **61**. The middle rail **62** is a slender plate-like rail with a length almost equal to that of the outer rail **61**. A protrusion **62***a* protruding toward the reverse side and extending in the length direction (sliding direction) of the plate is formed on the slender plate of the middle rail **62**. The bent edges **62***b*, which are bent toward the reverse side, are formed on the opposite side parts of the plate of the middle rail **62**. As shown in FIG. **4**A, which shows the reverse side of the middle rail **62**, and FIG. **4**B, which is an enlarged view of the main part on the inner side of the middle rail **62**, linear sliding grooves **62***c*, **62***d* are formed in the inner and outer parts of the respective bent edges **62***b*, respectively, so that a small diameter ball can roll in the sliding direction.

Two (plural) metal ball retainers **64**, **65** are provided in the middle rail **62**, that is, between the two bend edges **62***b*. The ball retainers **64**, **65** are each formed of a comparatively thin metal plate member having a substantially C shape slightly smaller than the middle rail **62**. The ball retainers **64**, **65** each include a plurality of ball bearings **66**. The ball bearings **66** are arranged at predetermined intervals in the sliding direction in parts of the middle rail **62**, which face the respective bent edges **62***b*. Balls **66***a* are rotatably held by the bearings **66**. The ball retainers **64**, **65** are inserted in the middle rail **62** in a manner that the balls **66***a* of the ball bearings **66** engage with the respective sliding groove **62***c* inside the two bent edges **62***b*.

With the above configuration, the balls **66***a* roll on the respective grooves **62***c* inside the two bent edges **62***b* of the middle rail **62**, so that the ball retainers **64**, **65** can freely slide in the sliding direction along the middle rail **62**. The respective balls **66***a* of the ball bearings **66** also face the sliding grooves **62***c*, which are linearly formed in the longitudinal direction and allow the inner rail **63** to slide, on the inner sides of the bent edges **62***b*. This enables the inner rail **63** to be slidable relative to the middle rail **62**. In addition, though not shown, linear sliding grooves are formed inside the two bent edges **61***a* of the outer rail **61**. A ball retainer similar to the ball retainer **64** is provided at the outer rail **61**. Ball bearings of the ball retainer face the respective sliding grooves inside the bent

edges **61***a* and the sliding grove **62***c* of the middle rail **62**. The middle rail **62** is held so as to be slidable relative to the outer rail **61**.

Moreover, the ball retainer **64** of the ball retainers **64**, **65** serves as a guide retainer **64** arranged at the front end part of the middle rail **62**, that is, on the side of the front panel **22***a* in FIG. **2**. As shown in FIGS. **4**A and **4**B, the guide retainer (ball retainer) **64** includes three ball bearings **66** on each of the opposite sides thereof and is short enough when compared with the other ball retainer **65**. The guide retainer **64** is arranged at the front end part of the middle rail **62** so as to be slidable within a predetermined range. Further, the other ball retainer **65** has a length about one half of that of the middle rail **62**, for example.

A guide member **80** is mounted and fixed by means of a bolt or the like on the further front side than the guide retainer **64** in the front end part of the middle rail **62**, that is, the foremost end of the middle rail **62**. The guide member **80** guides the inner rail **63** in mounting the inner rail **63** on the middle rail **62**. Further, the guide member **80** also functions as a restriction member that restricts frontward sliding of the guide retainer **64**.

Furthermore, a pair of restriction members **81** is provided at the middle rail **62**. The pair of restriction members **81** is provided at a part which is closer to the center of the middle rail **62** in the sliding direction (length direction) than the guide member **80**. The pair of restriction members **81** restricts sliding of the guide retainer **64** toward the center (rearward of the middle rail **62** (fixed rail)). The pair of restriction members **81** is formed by raising parts of the protrusion **62***a* of the middle rail **62**. However, the restriction members may be protrusions mounted by means of a bolt, welding, adhesive, or the like, or may be directly formed with a bolt.

The guide retainer **64** is interposed between the restriction members **81** and the guide member **80**. For this reason, the guide retainer **64** is slidable in the sliding direction along the middle rail **62** only within the predetermined range restricted by the restriction members **81** and the guide member **80**. The predetermined range is a range of about 1 to 2 cm, for example, within which the guide retainer **64** can move in the sliding direction along the middle rail **62**. That is, the distance between the restriction members **81** and the guide member **80** is about 1 to 2 cm longer than the length of the guide retainer **64**.

It is noted that as a restriction member that defines the slidable range (predetermined range) of the guide retainer **64**, for example, a long hole is formed in the central part of the guide retainer **64**, and a protrusion, such as a blot or the like to engage with the long hole is formed so as to movable relative to the long hole.

The guide member **80** is a resin member including a mounting plate **80***a*, a pair of fitting protrusions **80***b*, a pair of support protrusions **80***c*, and a cushioning portion **80***d*. The pair of fitting protrusions **80***b* is formed on the opposite sides of the mounting plate **80***a*. The pair of support protrusions **80***c* is formed closer to the center of the guide member **80** than the pair of fitting protrusions **80***b*. The cushioning portion **80***d* is an arc-shaped member formed at the tip end of the mounting plate **80***a*. Grooves **80***e* between the fitting protrusions **80***b* and the support protrusions **80***c* of the guide member **80** each serve as a guide portion to receive the tip end part of the inner rail **63**, that is, a part thereof on the opposite side to the front panel **22***a* shown in FIG. **2**. Further, as shown in FIG. **4**B, each one of the end surfaces **80***f* of the two support protrusions **80***c*, that is, the end surface **80***f* of each support protrusion **80***c* on the front side of the middle rail **62** inclines so as to be close to the center of the middle rail **62** as it goes away from the mounting plate **80***a*.

The grooves **80***e* are opened into the guide retainer **64**. Accordingly, the inner rail **63** going along the groove **80***e* is directly guided to the guide retainer **64** to slide. Here, the width and depth of the groves **80***e* of the guide member **80** are larger than the thickness and length of bent edges **63***a* of the inner rail **63**, which will be described later. Accordingly, frictional drag, which would prevent the inner rail **63** from sliding, is less caused. Further, the protruding surfaces of the support protrusions **80***c* are out of contact with the inner rail **63** with a predetermined interval left.

FIG. **5**A is a perspective view of the slide rail **60** as viewed from the obverse side. As shown in FIG. **5**A, the inner rail **63** is a metal member having a substantially C-shaped transvers cross section smaller than the middle rail **62**. The inner rail **63** is a slender plate-like member with a length almost equal to that of the middle rail **62**. The bent edges **63***a* are formed on the opposite sides of the slender plate. Each of the two bent edges **63***a* is formed to extend toward the middle rail **62**. A linear slide groove **63***b* is formed in the longitudinal direction in each of the outer surfaces of the two bent edges **63***a*. The balls **66***a* are held by the ball bearings **66** of the guide retainer **64** and the ball retainer **65**. The bent edges **63***a* are guided to the grooves **80***e* of the guide member **80** and engage then with the balls **66***a* to slide on the grooves **80***e*.

FIG. **5**B is an enlarged view of the main part in FIG. **5**A. As shown in FIG. **5**B, the inner rail **63** is provided with a locking member **82** that locks the inner rail **63** in the middle rail **62**. The locking member **82** can prevent the inner rail **63** from falling off from the middle rail **62**. The locking member **82** is a slender flexible plate-like member made of resin. FIG. **6** is a view showing the inner side of the middle rail **62** with the locking member **82**, from which the inner rail **63** is taken out. As shown in FIG. **6**, the locking member **82** includes a slender plate-like support portion **83** and a functional portion **84**. The functional portion **84** is substantially square in shape.

The locking member **82** is bent in a manner that the support portion **83** and the functional portion **84** form an L shape in combination to form an angle when viewed from a side. That is, the locking member **82** is formed in a manner that both the ends of the locking member **82** are in contact with the inner rail **63**, while the central part thereof separate from the inner rail **63**.

As shown in FIG. **5**B, the support portion **83** has one end, which engages with and is held by a protrusion piece **85** for mounting formed at the inner rail **63**. Further, as shown in FIG. **6**, the support portion **83** is formed to have a width that allows the support portion **83** so as to be capable of passing between the two support protrusions **80***c* of the guide member **80** and be movable between the two support protrusions **80***c*.

On the other hand, the functional portion **84** is formed wider than the support portion **83**. Therefore, each end of the two support protrusions **80***c* of the guide member **80** catches the end of the functional portion **84** on the side of the support portion **83**, so that the functional portion **84** cannot pass between the two support protrusions **80***c*.

As indicated by the arrows in FIGS. **6** and **5**B, when the support portion **83** is pushed from the obverse side toward the reverse side of the slide rail **60**, the locking member **82** becomes flat along the surface on the outer side of the inner rail **63** from the bent L shape. As a result, the support portion **83** and the functional portion **84** recede toward the inner rail **63** more than the protruding surfaces of the support protrusions **80***c* of the guide member **80**. Thus, the functional portion **84** caught by the two support protrusions **80***c* is released.

Description will be made next about an operation of the slide rail **60** configured as above.

In order to take out, for example, the sheet feed cassette **22** from the sheet feed cassette accommodating section **21** shown in FIG. **2** in the printer shown in FIG. **1**, the sheet feed cassette **22** is pulled out in the direction indicated by the arrow in FIG. **2**. The middle rail **62** is slidably held by the outer rail **61**. The inner rail **63** is slidably held by the middle rail **62** through the guide retainer **64** and the ball retainer **65**. Accordingly, the sheet feed cassette **22** can be easily and smoothly drawn out from the sheet feed cassette accommodating section **21**.

However, the inner rail **63** is provided with the locking member **82**. As such, the functional portion **84** of the locking member **82** is caught by the support protrusions **80***c* of the guide member **80**, as shown in FIG. **6**. Thus, the inner rail **63** is incapable of being drawn out from the middle rail **62** farther more. It is noted that in this state, the support portion **83** of the locking member **82** is exposed on the obverse side of the slide rail **60**, as shown in FIG. **2**.

Accordingly, an operator pushes the support portion **83** in the direction indicated by the arrows in FIGS. **6** and **5**B, that is, toward the inner rail **63**. Then, as described above, this makes the functional portion **84** to recede toward the inner rail **63** more than the protruding surfaces of the support protrusions **80***c* of the guide member **80**, thereby releasing catch of the functional portion **84** by the two support protrusions **80***c*. Accordingly, when the sheet feed cassette **22** is further pulled out in this state, the sheet feed cassette **22** can be taken out from the sheet feed cassette accommodating section **21**. That is, the inner rail **63** can be taken out from the middle rail **62**.

In order to accommodate again the sheet feed cassette **22** in the sheet feed cassette accommodating section **21** after the sheet feed cassette **22** is taken out in this manner, the tip end parts of the two bent edges **63***a* of the inner rail **63** are aligned with the grooves **80***e* of the guide member **80** of the middle rail **62**. Then, the sheet feed cassette **22** is pushed into the sheet feed cassette accommodating section **21** in this state. This makes the tip end of the inner rail **63** to be guided to the grooves **80***e* of the guide member **80** and directly to the ball bearings **66** of the guide retainer **64**. Thus, since the guide retainer **64** is arranged on the front end part of the middle rail **62** to open into the grooves **80***e*, the tip end parts of the two bent edges **63***a* of the inner rail **63** can be smoothly guided to the ball bearings **66** of the guide retainer **64**.

The guide retainer **64** is slidable within the predetermined range. Accordingly, the tip end part of the inner rail **63**, which is guided to the ball bearings **66** of the guide retainer **64**, can be more smoothly inserted into the middle rail **62** with the aid of both sliding of the inner rail **63** relative to the guide retainer **64** and sliding of the guide retainer **64** relative to the middle rail **62**.

The tip end part of the inner rail **63**, which is inserted as above in the ball bearings **66** of the guide retainer **64**, slides directly and horizontally through the middle rail **62** to be guided by the ball bearings **66** of the ball retainer **65** to slide. That is, the inner rail **63** moves in the sliding direction along the middle rail **62**. In so doing, the inner rail **63** moves more smoothly through the middle rail **62** with the aid of both sliding of itself relative to the ball retainer **65** and sliding of the ball retainer **65** relative to the middle rail **62**.

Still further, in moving the inner rail **63** along the middle rail **62** as above, the locking member **82** of the inner rail **63** receives no pressure, and accordingly, remains in the bent L shape as shown in FIG. **6**. Accordingly, the functional portion **84** of the locking member **82**, which is located on the tip end side in the moving direction of the inner rail **63**, inclines in a manner that its tip end is in contact with the inner rail **63**, while the part on the side of the support portion **83** separates from the inner rail **63**. Thus, the functional portion **84** on the tip end side of the locking member **82** forms the inclined surface. Also, each end surface **80***f* of the support protrusions **80***c* of the guide member **80** forms the inclined surface. Accordingly, when the inner rail **63** is inserted in and moved along the middle rail **62**, the locking member **82** can easily ride over the two support protrusions **80***c* of the guide member **80**.

Thereafter, when the functional portion **84** of the locking member **82** comes in contact with the support protrusions **80***c* of the guide member **80** after riding on and passing over the end surfaces **80***f* of the support protrusions **80***c*, the inclined surface of the functional portion **84** is pushed by the support protrusions **80***c* to be flat. Subsequently, the inner rail **63** moves in the sliding direction along the middle rail **62** in this state, so that the locking member **82** passes over the support protrusions **80***c* of the guide member **80** to be returned to the original bent L shape.

When the sheet feed cassette **22** is pushed further toward the sheet feed cassette accommodating section **21**, the middle rail **62** also slides along the outer rail **61**. Finally, the middle rail **62** is accommodated in the outer rail **61**. The inner rail **63** is accommodated in the middle rail **62**. Thus, the sheet feed cassette **22** is accommodated in the sheet feed cassette accommodating section **21**.

The two ball retainers **64**, **65** are arranged in the sliding direction along the middle rail **62** in the above slide rail **60**. One of the ball retainers **64**, **65** serves as the guide retainer **64** arranged at the front end part of the middle rail **62**. Accordingly, arrangement of the guide retainer **64** always at the front end part of the middle rail **62** enables easy confirmation by sight of the guide retainer **64** in inserting and fitting the inner rail **63** into the middle rail **62**. Thus, insertion of the inner rail **63** into this guide retainer **64** can result in easy fitting of the inner rail **63** into the middle rail **62**.

Furthermore, the guide retainer **64** includes the ball bearings **66**. Accordingly, frictional drag is hardly caused between the guide retainer **64** and the inner rail **63**, which can allow the inner rail **63** to favorably slide, thereby achieving favorable sliding performance. Thus, the sheet feed cassette **22**, on which this inner rail **63** is mounted, can be inserted and fitted into the sheet feed cassette accommodating section **21** easily and smoothly. Further, favorable sliding performance of the sheet feed cassette **22** can be achieved.

Yet further, the guide retainer **64** is arranged so as to be slidable within the predetermined range in the front end part of the middle rail **62**. Accordingly, the guide retainer **64** slides along the middle rail **62** in inserting the inner rail **63** in the guide retainer **64**, thereby resulting in more favorable sliding of the inner rail **63**. Thus, more favorable sliding performance of the inner rail **63** can be achieved.

Moreover, the three ball bearings are disposed on each of the opposite sides of the guide retainer **64**. Accordingly, the guide retainer **64** comes in contact at its six points with the middle rail **62**. This means that the guide retainer **64** can be stably held by the middle rail **62** with less inclination and torsion. Thus, the guide retainer **64** can cause less backlash of the inner rail **63**. As a result, the inner rail **63** can be smoothly guided in the sliding direction along the middle rail **62**.

Still further, the guide retainer **64** is shorter than the other ball retainer **65** to form the other ball retainer **65** longer. Accordingly, in inserting the inner rail **63** into the middle rail **62**, the inner rail **63** can favorably slide along the middle rail **62** through the relatively long ball retainer **65**. Thus, the inner rail **63** can exhibit more favorable sliding performance.

Moreover, the guide member **80** is provided at the end of the middle rail **62**, which is located further frontward of the guide retainer **64**. This can guide the inner rail **63** easily to the guide retainer **64** through the guide member **80**. Thus, the inner rail **63** can be fitted into the middle rail **62** easily.

Yet further, the fixed rail includes the middle rail **62** and the outer rail **61**. This can make the stroke of the entire slide rail **60** large. Accordingly, even in the case of a drawer member (sheet feed cassette **22**) having a great depth, the drawing distance of this drawer member can be set large.

Furthermore, in the printer **1** (image forming apparatus) in the present embodiment, the drawer members can be accommodated in the main body **2** easily with favorable sliding performance.

The preferable embodiment has been described above with reference to the drawings. However, the present disclosure is not limited to the above embodiment. The shapes, combinations, etc. of the component members described in the above embodiment are mere examples and can be modified in various manners on the basis of design requirement and the like within the scope of the subject matter of the present disclosure.

The slide rail **60** according to the present disclosure is mounted between the sheet feed cassette **22** and the main body **2** in the above embodiment as one example. However, the slide rail **60** may be mounted between the duplex printing unit **30** and the main body **2**, for example. Further, the slide rail **60** may be mounted between a drawer (drawer member) and a main body of furniture or a kitchen, rather than the image forming apparatus (printer **1**).

Moreover, the fixed rail includes the middle rail **62** and the outer rail **61** in the above embodiment. However, in the case where not so large stroke is needed, the fixed rail may include only the middle rail **62**. In this case, the middle rail **62** serves as a rail directly fixed to a fixed member.

Yet further, the two ball retainers **64**, **65** are provided at the middle rail **62** in the above embodiment. However, three or more ball retainers may be provided.

Still further, although the three ball bearings **66** are provided in the sliding direction in the guide retainer **64**, two or four or more ball bearings **66** may be provided therein.

Furthermore, the printer is described in the above embodiment as one example of the image forming apparatus. However, the present disclosure is applicable to any other image forming apparatuses, such as copiers, etc. for example.

Yet further, in the above embodiment, the sliding direction is the same as the longitudinal direction of the fixed rail and the moving rail, which however should not be taken to limit the present disclosure. The sliding direction may be different from the longitudinal direction of the fixed rail and the moving rail. For example, the sliding direction may be the normal direction of the longitudinal direction of the fixed rail and the moving rail.

What is claimed is:

1. A slide rail, comprising:
- a plurality of plate-shaped ball retainers including ball bearings each holding a ball;
- a fixed rail on which the plurality of plate-shaped ball retainers are provided slidably in a sliding direction; and
- a moving rail arranged in the fixed rail and configured to engage with the ball bearings to be slidable relative to the plurality of plate-shaped ball retainers,
- wherein the fixed rail includes an engaging rail that engages with the ball bearings of the plurality of plate-shaped ball retainers,
- the moving rail is capable of being inserted into and drawn out from the engaging rail by being pulled frontward of the engaging rail to be taken out from the plurality of plate-shaped ball retainers or by being inserted into the plurality of plate-shaped ball retainers from front,
- the plurality of plate-shaped ball retainers aligned in one line in the sliding direction along the fixed rail,
- the plurality of plate-shaped ball retainers include a guide retainer arranged on a front end part of the engaging rail and an adjacent ball retainer rearwardly adjacent to the guide retainer in the sliding direction in the engaging rail,
- the engaging rail includes a restriction member located between the guide retainer and the adjacent ball retainer in the sliding direction,
- the guide retainer is located between the front end part of the engaging rail and the restriction member,
- the adjacent ball retainer is located between a rear end part of the engaging rail and the restriction member, and
- the restriction member restricts sliding of the guide retainer rearward of the engaging rail and sliding of the adjacent ball retainer frontward of the engaging rail.

2. The slide rail of claim **1**, wherein
- the guide retainer is arranged so as to be slidable within a predetermined range in the front end part.

3. The slide rail of claim **1**, wherein
- the guide retainer includes two or more ball bearings arranged in the sliding direction.

4. The slide rail of claim **1**, wherein
- the guide retainer has a length in the sliding direction shorter than the other of the ball retainers other than the guide retainer.

5. The slide rail of claim **1**, further comprising:
- a guide member provided at a front end of the engaging rail which is located further frontward than the guide retainer, and configured to guide insertion of the moving rail and restrict frontward sliding of the guide retainer.

6. The slide rail of claim **1**, wherein
- the fixed rail further includes an accommodating rail that accommodates the engaging rail,
- the fixed rail includes an outer rail as the accommodating rail mounted on a fixed member and a middle rail as the engaging rail provided in the outer rail so as to be slidable in the sliding direction, and
- the plurality of plate-shaped ball retainers are provided at the middle rail.

7. The slide rail of claim **1**, wherein
- the fixed rail has a substantially C-shaped transverse cross section.

8. The slide rail of claim **1**, further comprising
- a locking member configured to lock the engaging rail in the moving rail,
- wherein the moving rail is capable of being inserted into and drawn out from the fixed rail by being pulled frontward of the fixed rail upon release of the locking member to be taken out from the plurality of plate-shaped ball retainers or by being inserted into the plurality of plate-shaped ball retainers from front.

9. The slide rail of claim **1**, wherein
- the guide retainer guides insertion of the moving rail without moving from the front end part of the engaging rail.

10. An image forming apparatus, comprising:
- a main body;
- an image forming section and a fixing section, which are provided in an interior of the main body; and
- a drawer member capable of being drawn from the main body,

wherein the drawer member is accommodated so as to be capable of being inserted in and drawn from the main body through the slide rail of claim **1**.

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